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## Accepted Manuscript

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**The impact of psychiatric comorbidities on the length of hospital stay in patients with heart failure**

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PC, AC and JR were involved in the analysis and interpretation of data, drafting of the manuscript and final approval of the manuscript. RP, SC, SP and HU were involved in the conception and design, analysis and interpretation of data, critical revision of manuscript and final approval.

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**Abstract**

**Background:** Heart failure (HF) is a major healthcare problem contributing significantly to hospital admission stays and National Health Service (NHS) spending. Reducing length of hospital stay (LoS) in HF is paramount in reducing this burden and is influenced by factors relating to the condition, sociodemographics and comorbidities. Psychiatric comorbidities are being increasingly identified amongst HF patients but their impact on LoS has not been studied in the UK.

**Methods:** We investigated the impact of psychiatric comorbidities on LoS amongst 31760 HF patients admitted to hospitals in North England between 1st January 2000 and 31<sup>st</sup> March 2013 from the ACALM (Algorithm for Comorbidities, Associations, Length of stay and Mortality) study. The ACALM protocol uses ICD-10 and OPCS-4 coding to trace HF patients, psychiatric comorbidities and demographics including LoS.

**Results:** Amongst 31760 HF patients mean LoS in the absence of psychiatric comorbidities was 11.2 days. Presence of a psychiatric comorbidity increased LoS by 3.3 days. Logistic regression accounting for age, gender and ethnicity showed that LoS was significantly longer in patients suffering from depression (3.4 days,  $p<0.001$ ), bipolar disorder (8.8 days,  $p<0.001$ ) and all types of dementia (4.2 days,  $p<0.001$ ).

**Conclusions:** Our results demonstrate that psychiatric comorbidities have a significant and clinically important impact on LoS in HF patients in the UK. Clinicians should be actively aware of psychiatric conditions amongst HF patients and manage them to reduce LoS and ultimately the risk for patients and financial burden for the NHS.

## Introduction

Heart failure is an important pandemic affecting 26 million people globally<sup>1</sup>. In the United Kingdom alone it affects approximately 900 000 patients<sup>2</sup> and with a short survival time it is one of the leading causes of death<sup>3</sup>. 10-year mortality rate was estimated to be 42.8% by the NHANES-1 study which is comparable to the mortality rate associated with cancer<sup>4,5</sup>. This high morbidity and mortality means that heart failure consequently has a considerable global economic burden, which has been estimated to be \$108 billion (€100 billion) annually<sup>6</sup>. Expensive pharmacological treatments, community care and the frequent and prolonged hospital admissions<sup>7,8</sup> associated with the clinical course of the disease are important contributors to these costs. As a result, heart failure patients consume a considerable proportion of National Health Service (NHS) spending on hospital admissions, contributing 2% of all NHS in-patient bed-days and 5% of emergency admissions<sup>2</sup>. The average cost of a non-elective inpatient stay for heart failure patients is £1542 (\$2300 or €2100) and every excess day costs £275 (\$410 or €380)<sup>9</sup>. The burden of prolonged stays in heart failure patients is further demonstrated by the fivefold greater costs associated with an increase in length of hospital stay (LoS) from <4days to >7 days<sup>10</sup>, so it is essential that steps are taken to prevent prolonged inpatient stay. Reducing LoS could also prevent serious complications associated with hospital admissions, such as hospital-acquired infections which have a prevalence of 6.4%<sup>11</sup> and contribute significantly to mortality. These problems associated with extended LoS will become increasingly important as the burden of the disease rises with an ageing population and improved survival from the condition<sup>12</sup>. Optimising the timing of hospital discharge in heart failure patients could combat the health and social implications for the patient and financial implications for the NHS associated with prolonged LoS.

Research examining the determinants of prolonged length of stay in heart failure patients is therefore required. Although these factors have not been extensively studied there is some evidence for LoS being influenced by a number of factors relating to the condition such as the aetiology<sup>13</sup> and disease severity<sup>14</sup>, clinical presentation<sup>15</sup>, the ejection fraction<sup>14</sup> and the presence of peripheral oedema<sup>10</sup>. Other medical factors include those relating to treatment of heart failure, such as the duration of intravenous diuretic therapy<sup>10</sup>, use of harmful drugs<sup>16</sup> or development of iatrogenic complications<sup>17</sup>. Also important are socio-demographic factors<sup>18,19</sup> or the presence of either social problems or medical comorbidities which require treatment<sup>10, 18, 19, 20</sup>, of which various studies demonstrated renal impairment as a particularly important determinant of LoS in heart failure. These factors could be targeted; although the literature suggests LoS for heart failure patients has been shortening over recent times<sup>21</sup> so this data from older studies may not be relevant. As the LoS is

heavily influenced by NICE guidelines and protocols, newer studies based in the United Kingdom may identify new and more relevant determinants of length of stay to focus on.

An array of studies have demonstrated that suffering from comorbid psychiatric conditions are associated with significantly longer LoS<sup>23,24,25,26</sup> ranging from an extra 2.5 to 8.2 days in hospital<sup>27</sup>. Furthermore, a large review of 26 international outcome studies which were all focused on LoS in medical and surgical inpatients with comorbid psychiatric disease, LoS was increased and in particular was prolonged by diagnoses of dementia, delirium, depression and personality disorders<sup>28</sup>. These longer admission times represent a significant financial burden, with 1 in every £8 (\$12 or €10) of NHS spending estimated to be spent on psychiatric comorbidities. These detectable and manageable conditions are thus an important putative determinant of LoS in heart failure patients. The evidence for a similar impact of psychiatric conditions on LoS in heart failure patients is limited. Hochlennert et al demonstrated that cardiovascular inpatients in a German university hospital diagnosed with psychiatric conditions by the treating clinicians stayed in hospital for an average of 3 days longer<sup>29</sup>. This has been translated in the context of heart failure more specifically. In a study of 21,429 American patients LoS for those with a coded psychiatric comorbidity stayed in hospital up to 1.4 days longer and hospital costs for these patients were up to \$7 763 higher<sup>30</sup>. Aside from the financial cost, the LoS also has important implications on other clinical outcomes and is associated with increased readmission and higher mortality rates at 30 days and 1 year<sup>31</sup>. These studies together emphasise the importance of reducing costs and improving patient outcomes by reducing the LoS, but more studies are required to characterise the impact of psychiatric conditions in heart failure patients in the United Kingdom specifically.

With this in mind we aimed to study the impact of psychiatric comorbidities on LoS in a large database of patients admitted to hospitals in the North of England with heart failure. It has been previously demonstrated in two papers using this database that there is a large burden of cardiovascular disease amongst patients with psychiatric disease, with approximately 1 in 4 suffering from a cardiovascular comorbidity<sup>32,33</sup>. Psychiatric and cardiovascular disease is commonly seen together but the impact of these conditions on outcomes such as LoS should be studied further.

## Methods

### *Study Population*

We examined the impact of psychiatric co-morbidity on LoS in patients diagnosed with heart failure using an entirely anonymous database of adult patients compiled using the ACALM (Algorithm of Comorbidities, Associations, Length of stay and Mortality) study protocol which has been previously used and described by our group<sup>32-46</sup>. The ACALM study protocol uses ICD-10 (International Classification of Diseases and Related Health Problems, revision 10) diagnosis and OPCS-4 (Office of Population Censuses and Surveys Classification of Interventions and Procedures, version 4) procedure codes to identify patients from completely anonymous electronic hospital records.

The study population consisted of all 929 552 adult patients admitted to seven hospitals in North of England, UK, between 1<sup>st</sup> January 2000 and 31<sup>st</sup> March 2013. This start date was selected because it is when ICD-10 coding started being used widely in the hospitals included in the study. For patients with several hospitalizations, only the LoS data for their first hospitalization was included in the study. The target population we studied consisted of all 31 760 heart failure patients (3.4%) that were hospitalized during the study period. All patients with heart failure, diagnosed according to NICE guidelines<sup>2</sup>, and given an ICD-10 code for heart failure were included. Patients under the age of 18 were excluded. Data on LoS, age, gender, ethnicity, mortality and co-morbidities were available for all patients.

### *Psychiatric Co-morbidities*

The ACALM protocol was also used to identify patients coded for any psychiatric conditions. Anonymous raw information of registered discharge diagnoses of all patients admitted to seven hospitals in North of England, UK between 1<sup>st</sup> January 2000 and 31<sup>st</sup> March 2013 were received from the computerized analysis register of the local health authority. The ACALM protocol was then applied to transfer this raw data into an anonymous research database.

Psychiatric co-morbidities were traced using ICD-10 and OPCS-4 coding. We included any of psychiatric co-morbidity with a prevalence of 0.1% or greater for analysis. This consisted of the following ICD-10 codes; alcohol abuse, anxiety, bipolar disorder, all types of dementia, depression, opioid abuse, overdose, parasuicide, phobic disorders and schizophrenia. Physical comorbidities were also analysed as a comparison (type 2 diabetes mellitus, hypertension, chronic kidney disease, cerebrovascular disease, atrial fibrillation and anaemia). The final diagnoses, co-morbidities and procedural codes entered for each patient

is taken from the discharge diagnosis and therefore includes clinical information that becomes available later in the hospital stay.

#### *Data Analysis*

SPSS version 20.0 (SPSS Inc. Chicago, IL) was used for data analysis. To examine the impact of each psychiatric co-morbidity on length of stay a Student's t test was applied comparing mean LoS in patients with and without each co-morbidity in turn. A Levene's test for equality of variances was applied prior to the t test. P values were calculated two-tailed and  $p < 0.05$  were taken as significant. The methodology has been previously described and similarly used by our group and other groups previously.

#### *Research Governance*

The data used in this study was completed anonymous, non-identifiable and non-traceable. Appropriate ethics and research and development approvals were sought and obtained.



## Results

Out of 929 552 patients admitted during the study period there were 31 760 patients (3.4%) with heart failure. Demographics of the heart failure population are shown in table 1. The mean age of heart failure patients was 73.6, 50.3% were male and the majority were of Caucasian origin (85.1%). The majority of patients (66.4%) died during the study period.

The prevalence of psychiatric co-morbidities amongst heart failure patients were analysed and 12.7% were found to have at least one. All of the psychiatric co-morbidities with a prevalence of at least 0.1% amongst the heart failure patients are shown in table 2 and include; all types of dementia(6.78%), depression (3.23%), alcohol abuse (1.83%), anxiety disorders (1.10%), schizophrenia (0.56%), opioid abuse (0.26%), bipolar disorder (0.18%), parasuicide (0.15%), phobic disorders (0.14%) and overdose (0.12%).

To investigate the impact of these psychiatric co-morbidities on the LoS of heart failure patients Student's t tests were applied comparing the mean LoS in patients with and without each comorbidity. The mean LoS of heart failure patients with no psychiatric co-morbidities was 11.2 days. If any psychiatric co-morbidity was present this was significantly longer by 3.3 days (2.6-3.9, 95% CI). LoS in heart failure patients was 3.4 days longer in those suffering from co-morbid depression (2.1-4.7 days, 95% CI) and longer by 8.8 days in those with bipolar disorder (2.6-3.9, 95% CI). In particular, co-morbid dementia was associated with LoS ; by 4.2 days with a diagnosis of any type of dementia (3.3-5.1, 95% CI)). Of the patients with a psychiatric co-morbidity, patients with a single psychiatric co-morbidity were most common and these patients had significantly longer LoS compared to patients without psychiatric co-morbidities (3.6 days; 2.6-4.7 95% CI). Patients with two psychiatric co-morbidities also tended to have a longer LoS but this was not statistically significant due to a small number of patients (Table 2).

The prevalence of a selection of physical comorbidities amongst heart failure patients was also analysed as a comparison and are shown in table 2. LoS was significantly shorter in heart failure patients with comorbid Type 2 Diabetes (1.1 days shorter, 0.5 – 1.6 days 95% CI) and Hypertension (1.4 days shorter, 1.0-1.9 days, 95% CI). Patients with all other physical comorbidities had significantly longer LoS stay compared to heart failure patients without each comorbidity. LoS was longer by 9.0 days (8.2-9.8 days, 95% CI) in patients with comorbid Cerebrovascular Disease, by 1.5 days (0.8-2.1 days, 95% CI) in comorbid Chronic Kidney Disease, 1.8 days (1.3-2.3 days, 95% CI) in comorbid Atrial Fibrillation and 3.7 days (3.0-4.4 days, 95% CI) in comorbid Anaemia.

## Discussion

The results of our study show that heart failure patients with any comorbid psychiatric condition have a significantly longer LoS compared to those without one. This was most marked in patients suffering with comorbid bipolar disorder, followed by any type of dementia and depression. These findings have important implications for the efficient economical management of heart failure.

Our results are concordant with previous studies demonstrating a significantly longer LoS in inpatients with psychiatric conditions, and more specifically in those with comorbid cognitive impairment<sup>22,23,24,25,28</sup> and depression<sup>28</sup>. This was also true of patients with bipolar disorder, who had the longest LoS in our study. None of these prior studies were focused on heart failure patients though and only Sayers et al have studied the impact of psychiatric conditions in heart failure patients specifically. Although they demonstrated a longer LoS in heart failure patients with psychiatric comorbidities it was only prolonged by 1.4 days, they only included patients over the age of 65, and, they did not analyse the specific psychiatric comorbidities contributing to this increased LoS. We have therefore demonstrated a more clinically significant prolongation of LoS by psychiatric comorbidities in heart failure patients and have provided novel evidence as to which conditions are contributing. Furthermore, to our knowledge, this is the first study that has demonstrated that psychiatric comorbidities lengthen hospital stay in heart failure patients in the UK. Given that the length of hospitalisations and their overall financial costs depend greatly on service provisions and protocols in different countries this is an important finding.

There are an array of mechanisms by which these psychiatric comorbidities could be leading to an increased duration of hospitalisation in heart failure patients. Pharmacological mechanisms such as complications of treatments for psychiatric comorbidities or poor mental health interfering with adherence to heart failure treatment could be contributing. Underlying pathophysiological mechanisms such as activation of the hypothalamic-pituitary-adrenal axis, which occurs in depression, has also been proposed.<sup>30</sup> Similarly more social and pragmatic reasons could be important such as poor self-care, difficulty stabilising mental health patients, delay in discharge due to addressing social care problems or due to waiting for evaluation and treatment by liaison psychiatry services. The underlying reasons are likely to be multi-faceted and further research is required to characterise them.

With the current NHS financial crisis, and the fact that £1 in every £8 (\$12 or €10) spent on chronic conditions is related to poor mental health<sup>47</sup>, it is clear that curtailing mental health costs could have a large

impact on NHS expenditure. We have demonstrated that heart failure patients with psychiatric comorbidities had significantly prolonged hospital LoS by about 4 days compared to those without one, and this excess stay was even greater in bipolar patients who stayed in hospital for 8 days longer. Each excess inpatient day for heart failure patients costs £275 (\$410 or €380)<sup>9</sup>. Targeting this prolonged LoS could be an important way to reduce NHS expenditure and could be accomplished through faster diagnosis, optimization of care and working with community services in order to facilitate early discharge from hospital.<sup>48</sup> This approach has previously shown to be realistic, as demonstrated by Basildon and Thurrock University Hospital. In the year 2009/2010, the median LoS for heart failure admissions was reduced from 12 to 4 days, which released 1,249 bed days per year and saved £312,250 (\$470,000 or €440,000)<sup>47</sup>. Targeting the prolonged hospital stay that we have demonstrated in heart failure patients with psychiatric comorbidities (namely bipolar disorder, dementia and depression) could therefore be an effective and realistic way of reducing NHS expenditure.

### Limitations

Whilst the data encompasses a large number of patients and is therefore generalisable to the area studied (North West England, UK), the patient dataset is only based on one area of the UK and it is therefore not possible to generalise them to other areas. This is particularly important given our previously published data demonstrating that the prevalence of psychiatric comorbidities amongst cardiovascular patients varies considerably between Birmingham and Manchester<sup>32,33</sup>. Furthermore, we have not studied the difference in severity or length of diagnosis of heart failure in those with and without psychiatric comorbidities which could have contributed to our positive findings. A further development to this study would be the investigation of the length of the diagnosis of heart failure on psychiatric diagnoses and length of hospital stay. Lastly, we used LoS as a surrogate marker for the economic cost of the admission. Even though admissions generally cost more as the duration increases, many other factors, would contribute to the overall cost of the admission. Similarly, it cannot be assumed that a shorter admission will always be advantageous in terms of patient outcomes, and a premature discharge could lead to readmissions with longer hospital stays as well as poorer mortality. Patients with HF are cared for by specialist members of the multidisciplinary team, including HF specialist nurses and community based HF care. These services were available in the hospitals studied and in the community in the study locations. However it is plausible that varying access and availability to these services could have had an effect on length of stay and needs to be investigated further.

**Conclusion**

The findings of this study stress the importance of clinicians having a good awareness of mental health comorbidities in heart failure patients as well as a knowledge of their effective management in order to attempt to curtail the length of prolonged LoS. As an estimated £1 of every £8 spent by the NHS in England on chronic disease management is related to mental health comorbidity<sup>47</sup>, this will not only benefit the patient in terms of less time spent in hospital, but also help to reduce the huge financial burden in the healthcare system. Having an awareness of the susceptibility of these patients for prolonged LoS could facilitate proactive discharge planning for this patient group.

Table 1: Demographics amongst patients admitted with heart failure	
<b>Total number of heart failure patients</b>	31 760
<b>Mean Age<math>\pm</math>sd (years)</b>	73.6 $\pm$ 13.6
<b>n (%) Deceased</b>	21 090 (66.4%)
<b>n (%) Male</b>	15 965 (50.3%)
<b>Ethnicity n (%)</b>	
Caucasian	27 031 (85.1%)
South Asian	1 326 (4.2%)
Afro-Caribbean	455 (1.4%)
Oriental	73 (0.2%)
Mixed	45 (0.1%)
Other	358 (1.1%)
Unknown	2 472 (7.8%)
<b>Mean length of stay<math>\pm</math>sd (days)</b>	11.6 $\pm$ 20.2

**Table 2: Length of stay in patients with heart failure and comorbid diagnoses**

<b>Psychiatric Diagnoses</b>	<b>Prevalence n (%)</b>	<b>Mean LoS (Days)</b>	<b>Mean Difference in LoS (95% confidence intervals)</b>
<b>Physical Comorbidities</b>			
Type 2 Diabetes Mellitus	7021 (22.1%)	10.8	-1.1 (-1.6 - -0.5)***
Hypertension	13808 (43.5%)	10.8	-1.4 (-1.9 - -1.0)***
Cerebrovascular Disease	2655 (8.36%)	19.9	9.0 (8.2-9.8)***
Chronic Kidney Disease	4881 (15.4%)	12.8	1.5 (0.8-2.1)***
Atrial Fibrillation	10992 (34.6%)	12.8	1.8 (1.3-2.3)***
Anaemia	3823 (12.0%)	14.9	3.7 (3.0-4.4)***
<b>Psychiatric Comorbidities</b>			
No psychiatric co morbidity	27757 (87.4%)	11.2	0.0 #
All psychiatric co morbidities	4042 (12.7%)	14.5	3.3 (2.6-3.9)***
Dementia (All types)	2152 (6.78%)	15.5	4.2 (3.3-5.1)***
Depression	1025 (3.23%)	14.9	3.4 (2.1-4.7)***
Alcohol Abuse	581 (1.83%)	11.4	-0.2 (-1.7-1.2)
Anxiety Disorders	350 (1.10%)	10.3	-1.3 (-4.1-1.5)
Schizophrenia	179 (0.56%)	13.0	1.4 (-2.1-4.9)
Opioid Abuse	84 (0.26%)	15.4	3.8 (-3.4-11.0)
Bipolar Disorder	58 (0.18%)	20.4	8.8 (3.5-14.2)***
Parasuicide	49 (0.15%)	11.1	-0.5 (-7.5-6.6)
Phobic Disorders	44 (0.14%)	8.1	-3.5 (-7.1- 0.0)
Overdose	39 (0.12%)	7.9	-3.7 (-10.4-2.9)
<b>Number of psychiatric comorbidities</b>			
1	3595 (11.3%)	14.7	3.6 (2.7-4.4)***
2	387 (1.2%)	12.0	1.8 (-1.0-4.6)
3	48 (0.2%)	9.9	-1.3 (-7.8-5.3)
4	12 (0.0%)	7.1	-4.0 (-10.2-2.1)
<p>The absolute difference in the mean LoS in heart failure patients with the psychiatric/physical diagnoses are compared to all patients with heart failure who do not have each diagnosis. Difference in length of stay is measured in days and presented with 95% confidence intervals. A positive value represents a longer length of stay in the group with comorbid illness.</p> <p># Patients with psychiatric/physical comorbidities were compared to those without each comorbidity  LoS= Length of hospital stay NOS = Not Otherwise Specified * = p&lt;0.05 ** = p&lt;0.01 *** = p&lt;0.001</p>			

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**Figure 1:** Length of stay in patients with heart failure and comorbid psychiatric diagnoses (Mean LOS and SEM)

